DOCUMENT RESUME

ED 286 161 CS 008 930

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TITLE Developmental Changes in the Understanding of Simple and Complex Causal Relations in Stories.
PUB DATE Apr 87
NOTE 16p.; Paper presented at the Biennial Meeting of the Society for Research in Child Development (Baltimore, MD, April 23-26, 1987).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Abstract Reasoning; Adolescents; Age Differences; Children; *Cognitive Development; Cognitive Measurement; Cognitive Tests; Developmental Stages; *Inferences; Logical Thinking; *Reading Comprehension; Reading Processes; Reading Research; Story Reading; Synthesis
IDENTIFIERS *Causal Inferences

ABSTRACT

This study investigated the development of students' abilities to integrate information in stories as an aspect of reading comprehension. Students aged 8, 11, 14, and 18 judged the importance of key statements, which varied in their causal relations within an episode, between episodes, and in a higher-order structure, yielding three levels of possible integration. Results showed that within an episode, all age groups judged to the same degree statements that causally integrated many other statements as more important than statements that integrated few other statements. However, only students 11 years old and older recognized the importance of statements that related pairs of episodes. Further, not until students were 14 could they identify statements that allowed higher-order structuring of episodes as important. The findings attest to the central role that causal inferences play in the integration of information in stories. While students of all age groups were sensitive to the causal role of statements within episodes, the ability to infer causal relations at higher levels of integration appears to be strongly related to age and grade level. (Five figures and one table are included.) (JC)

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# Developmental Changes in the Understanding of Simple and Complex Causal Relations in Stories

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Paper presented at the Biennial Meeting of the Society for Research in Child Development in Baltimore, Maryland, 1987.

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CS008930

## Abstract

The present study investigated the development of the ability to integrate information in stories. Key statements varied in their causal relations within an episode, between episodes, and in a higher-order structure, yielding three levels of possible integration. Eight, eleven, fourteen and eighteen-year old students judged the importance of these key statements.

The results showed that within an episode all age groups judged to the same degree statements that causally integrated many other statements as more important than statements that integrated few other statements. However, only students eleven years and older recognized the importance of statements that related pairs of episodes. Further, not until students were fourteen did they identify statements that allowed higher-order structuring of episodes as important.

These findings attest to the central role that causal inferences play in the integration of information in stories. While students in all age groups were sensitive to the causal role of statements within episodes, the ability to infer causal relations at higher levels of integration appears to be highly related to age and grade levels.

## Introduction

In the comprehension of stories, integration of information across sentences plays a major role. That is, in order to form a coherent representation of the discourse, one must make inferences that causally connect the ideas contained in the series of sentences. The purpose of this study is to investigate the development of the ability to make these connecting inferences.

### Levels of Integration

One can distinguish at least three levels of integration in stories. First, causal relations may occur within an episode in the story, linking its goals, actions and outcomes. Second, connecting inferences can be made between episodes: For example, goals and successful outcomes in one episode may cause or enable goals or outcomes in other episodes. Similarly, a failed outcome in one episode may cause a subordinate goal and start a new episode. Third, groups of episodes can be linked at a higher-order level by a shared topic or by causal chaining.

### Developmental Expectations

The extent to which children can achieve integration at the different levels can be taken as an indication of the development of their comprehension skills. As the amount of information to be connected becomes larger, the cognitive demands on inference-making increase. As a result, the ability to make the inferences that are necessary for within-episode integration is expected to develop before that of making the inferences that are required for between-episode integration. In turn, the latter is expected to develop before the ability to infer relations that underlie higher-order integration.

The Study

To test this hypothesis, statements were varied systematically in their causal relations to other statements in a story while their content was held constant. As a result, they changed with respect to their function in integrating information at each level of integration and hence in their importance to the text as a whole. The development of the ability to infer relations at each level was investigated by having subjects from various age groups judge the importance of the statements.

## Systematic Variations and Expectations

Four versions of two stories were made. In the sequential version, three episodes followed each other and relationships between them were those of enablement. In the hierarchical version, the episodes were embedded and the inter-episodic relations were causal (see Figure 1 and Table 1). Two additional hierarchical versions were made by adding or deleting actions within episodes.

### Integration within Episodes

Within an episode, a goal gives rise to actions and an outcome, while the actions also enable the outcome. By adding or deleting actions from an episode, the number of causal relations of the goal were varied systematically. The more relations a goal has, the more central it is in integrating the episode and hence the more important it is expected to be judged.

### Integration Between Pairs of Episodes

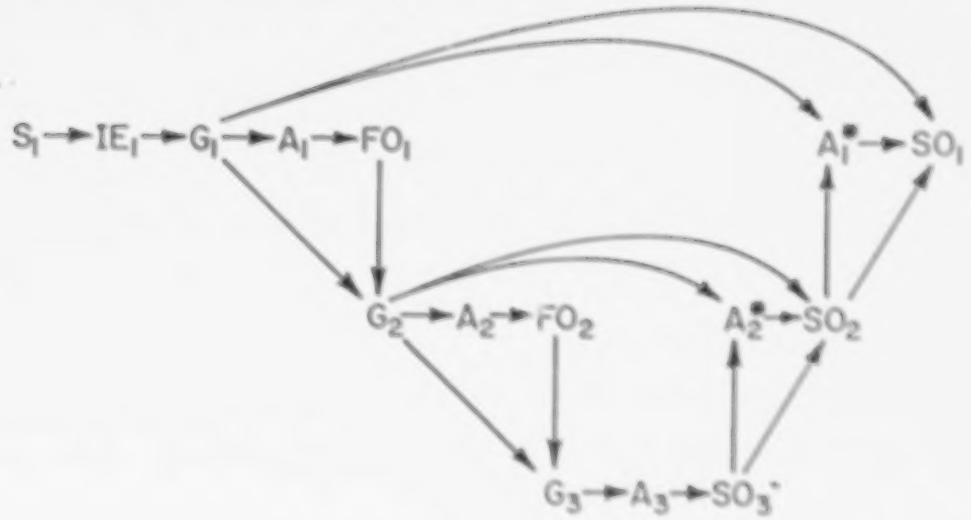
Statements vary in their roles in connecting episodes. Goal and outcome statements anchor and interconnect the episodes. In contrast, the role of actions is entirely intra-episodic. Thus, goals and outcomes play a more central role in integrating episodes and therefore are expected to be judged more important than actions.

Failed outcome statements differ in their inter-episodic role across the story versions. In the hierarchical versions, they generate subgoals and hence connect episodes. In the sequential version, they only lead to one subsequent event within the same episode. Therefore, we expect failed outcomes to be judged more important in the hierarchical than in the sequential versions.

Integration in a Higher-order Structure

The sequential version derives its coherence from the fact that all episodes are topically organized around the same protagonist, introduced in the setting statement. In contrast, the episodes in the hierarchical version are causally related. As a result, the setting statement should play a more important role in the sequential than in the hierarchical version.

HIERARCHICAL STORY




SEQUENTIAL STORY

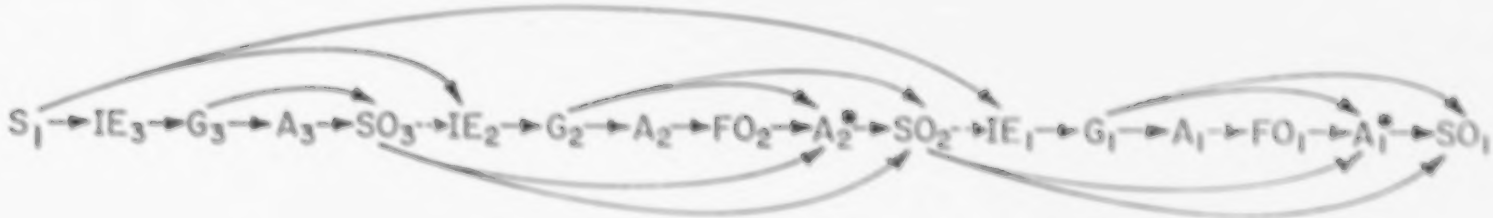



FIGURE 1. STRUCTURAL REPRESENTATION OF KEY STATEMENTS IN THE HIERARCHICAL AND SEQUENTIAL STORY VERSIONS. (NODES REFER TO STATMENTS; SEE TABLE 1. ARCS INDICATE CAUSAL RELATIONS).

Table 1

Key to Statements in Figure 1

| Episode | Category | | Content |
|---|---|---|---|
| | Setting | S1 | There once was a boy named Jimmy. |
| | Initiating Event | IE1 | Jimmy saw Tom's new 10-speed bike. |
| | Goal | G1 | Jimmy wanted a 10-speed bike. |
| 1 | Action | A1 | Jimmy counted the money he had with him. |
| | Failed Outcome | FO1 | The money was not enough to buy a bike. |
| | Action | A1* | Jimmy took the money he had saved. |
| | (Example inserted action | A1* | Jimmy went to the bike shop.) |
| | Successful Outcome | SO1 | Jimmy bought a beautiful bike. |
| | Initiating Event | IE2 | Jimmy did not have much money. |
| | Goal | G2 | Jimmy wanted to save $100. |
| | Action | A2 | Jimmy asked his mother for some money. |
| 2 | Failed Outcome | FO2 | Jimmy's mother said that he should earn his own money. |
| | Action | A2* | Jimmy delivered the newspapers before sunrise. |
| | (Example inserted action | A2* | Jimmy made sure he didn't miss any house.) |
| | Successful Outcome | SO2 | Jimmy got a lot of tips and saved $100. |
| | Initiating Event | IE3 | Jimmy had a lot of spare time. |
| | Goal | G3 | Jimmy wanted to get a paper route. |
| 3 | Action | A3 | Jimmy went to the newspaper office. |
| | (Example inserted action | A3* | Jimmy asked the manager about a paper route.) |
| | Successful Outcome | SO3 | Jimmy accepted a paper route. |

(Note: '*' indicates multiple occurrences of statement category in an episode.)

## Results

### Integration within Episodes (Figure 2)

The judged importance of goal statements increased linearly as a function of their number of causal relations to other statements in the same episode. This finding was obtained for each age group.

### Integration between Episodes (Figure 3 and 4)

Subjects at all age levels judged goals and outcomes to be more important than actions. However, the difference in importance of these statements was significantly larger for the subjects eleven years and older than for those eight-years old.

Similarly, only subjects eleven years and older judged failed outcomes more important in the hierarchical versions than in the sequential versions.

### Integration in a Higher-order Structure (Figure 5)

Setting statements were judged more important in the hierarchical than in the sequential versions by the two oldest age groups, the fourteen and seventeen-year old subjects. The eight and eleven-year olds judged the setting statements equally important in both versions.

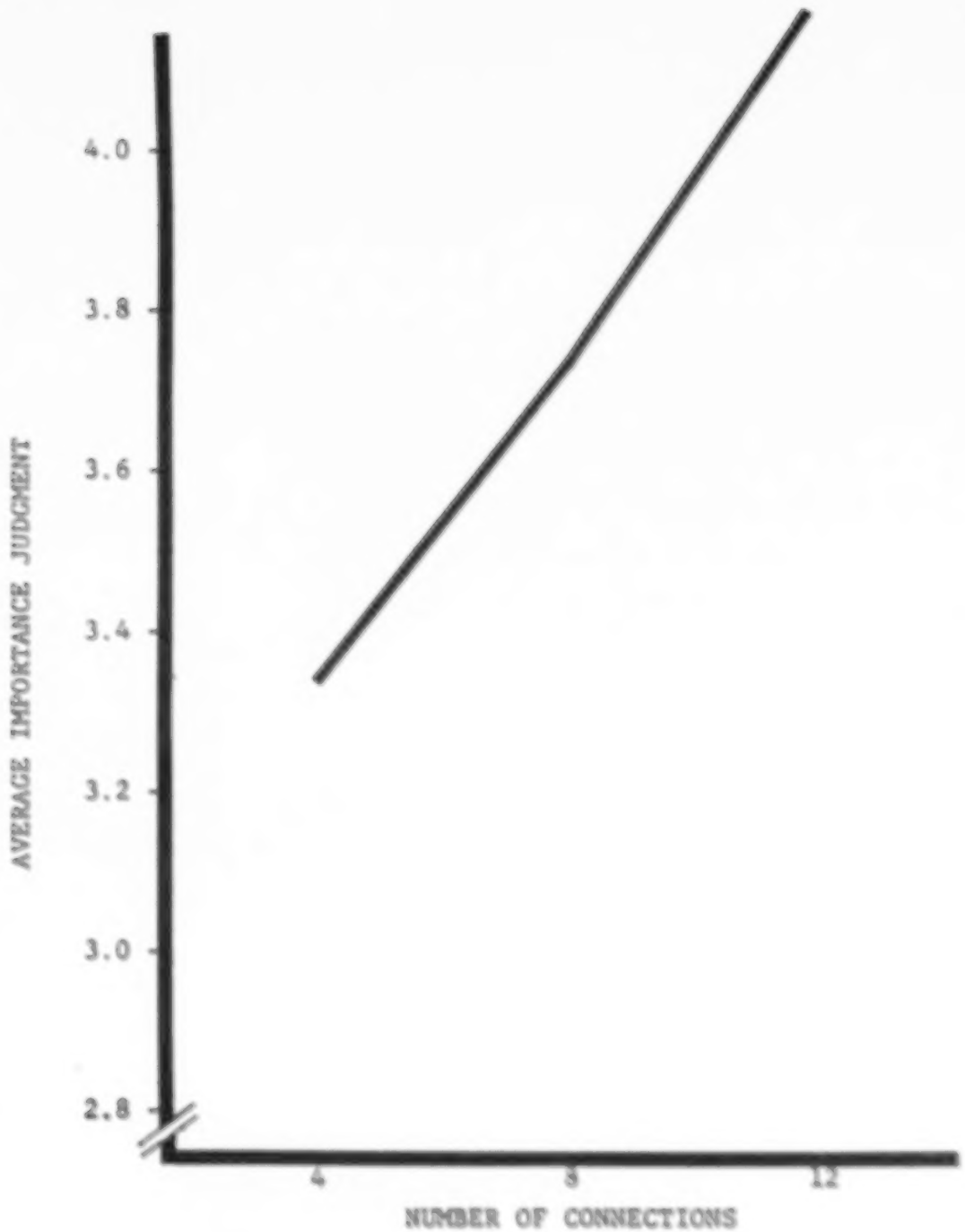



FIGURE 2. WITHIN-EPISODE INTEGRATION: AVERAGE GOAL STATEMENT IMPORTANCE AS A FUNCTION OF CAUSAL CONNECTIONS.

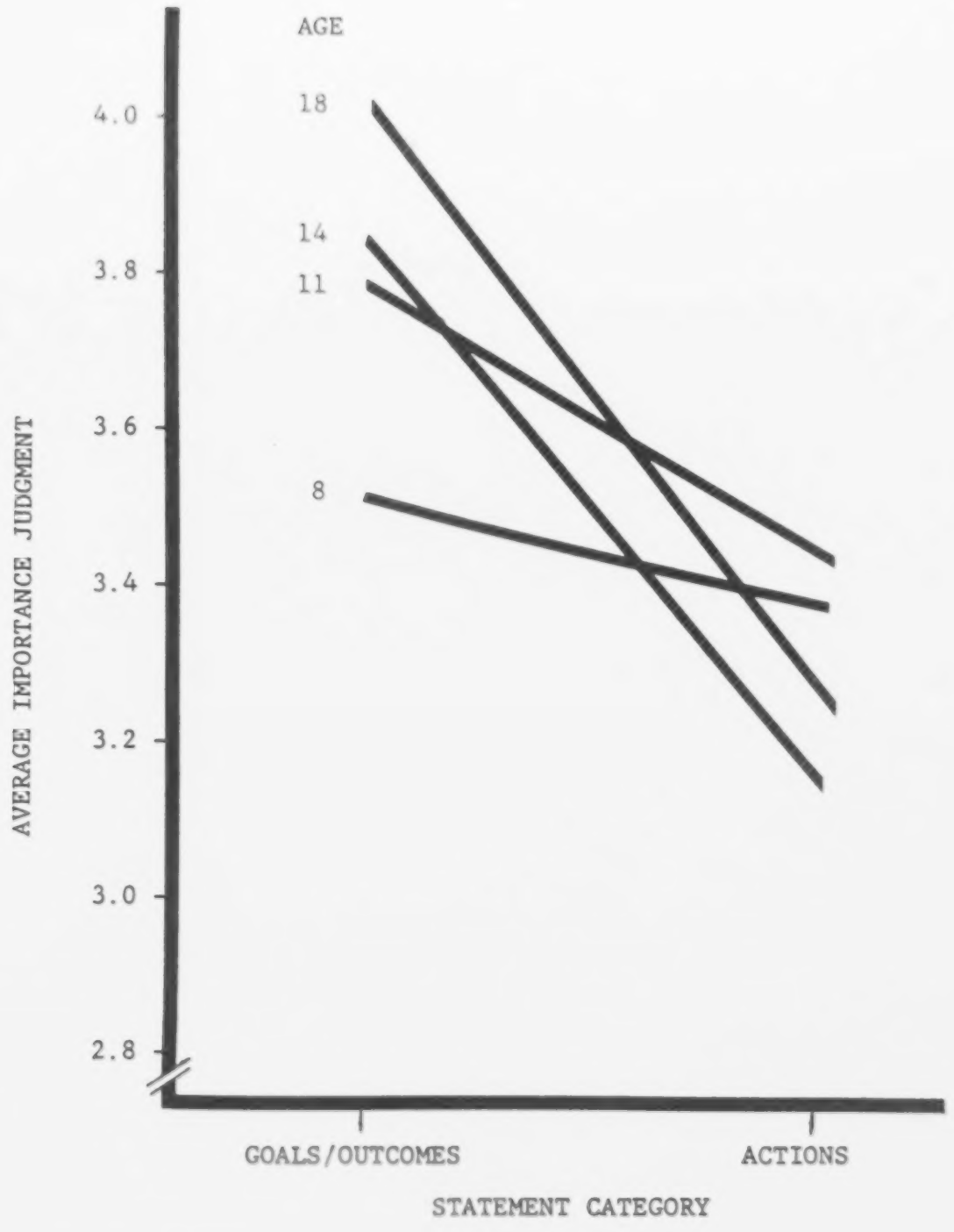



FIGURE 3. BETWEEN-EPISODE INTEGRATION: AVERAGE IMPORTANCE JUDGMENTS OF GOALS/SUCCESSFUL OUTCOMES AND ACTIONS FOR EACH AGE GROUP.

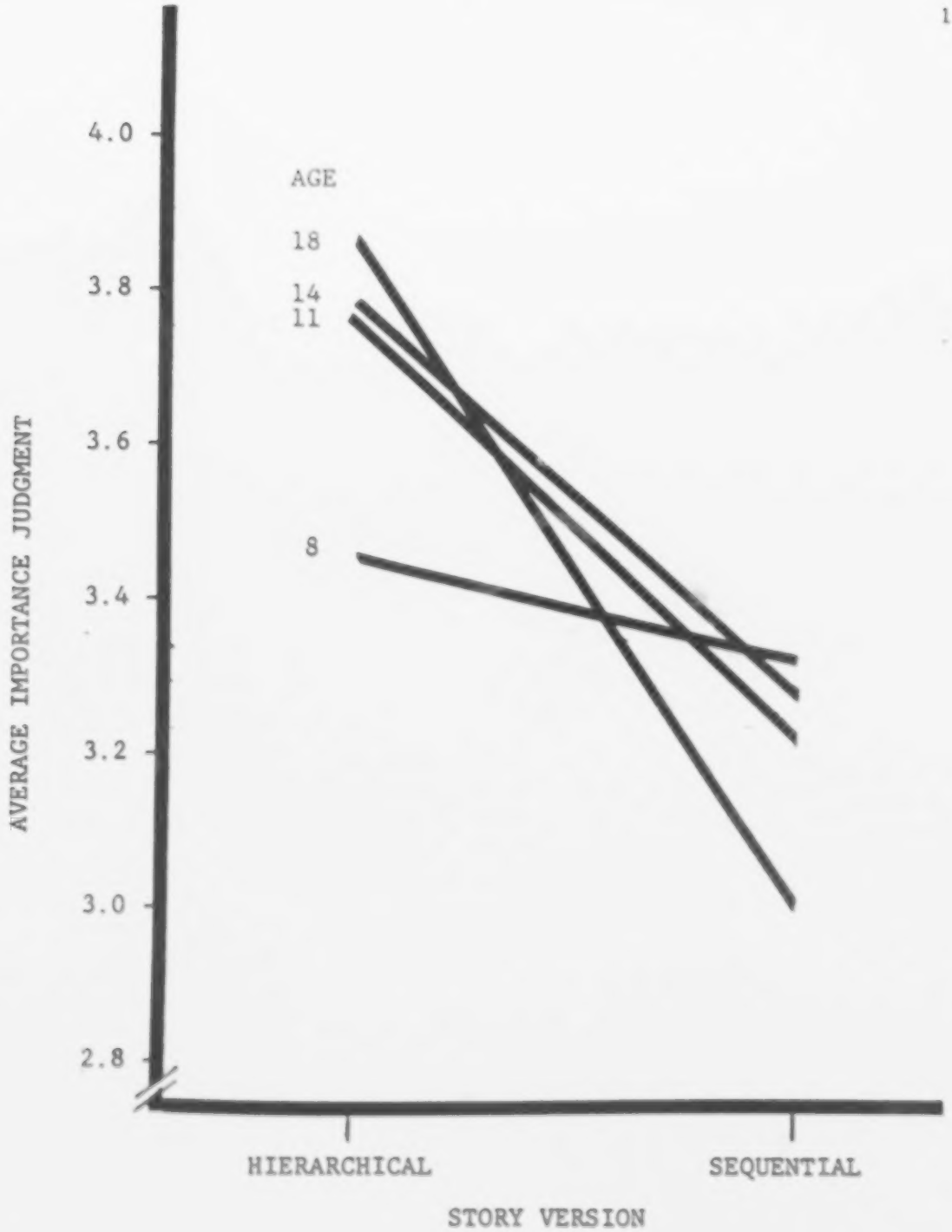



FIGURE 4. BETWEEN-EPISODE INTEGRATION: AVERAGE IMPORTANCE JUDGMENT FOR FAILED OUTCOMES IN HIERARCHICAL AND SEQUENTIAL VERSIONS FOR EACH AGE.

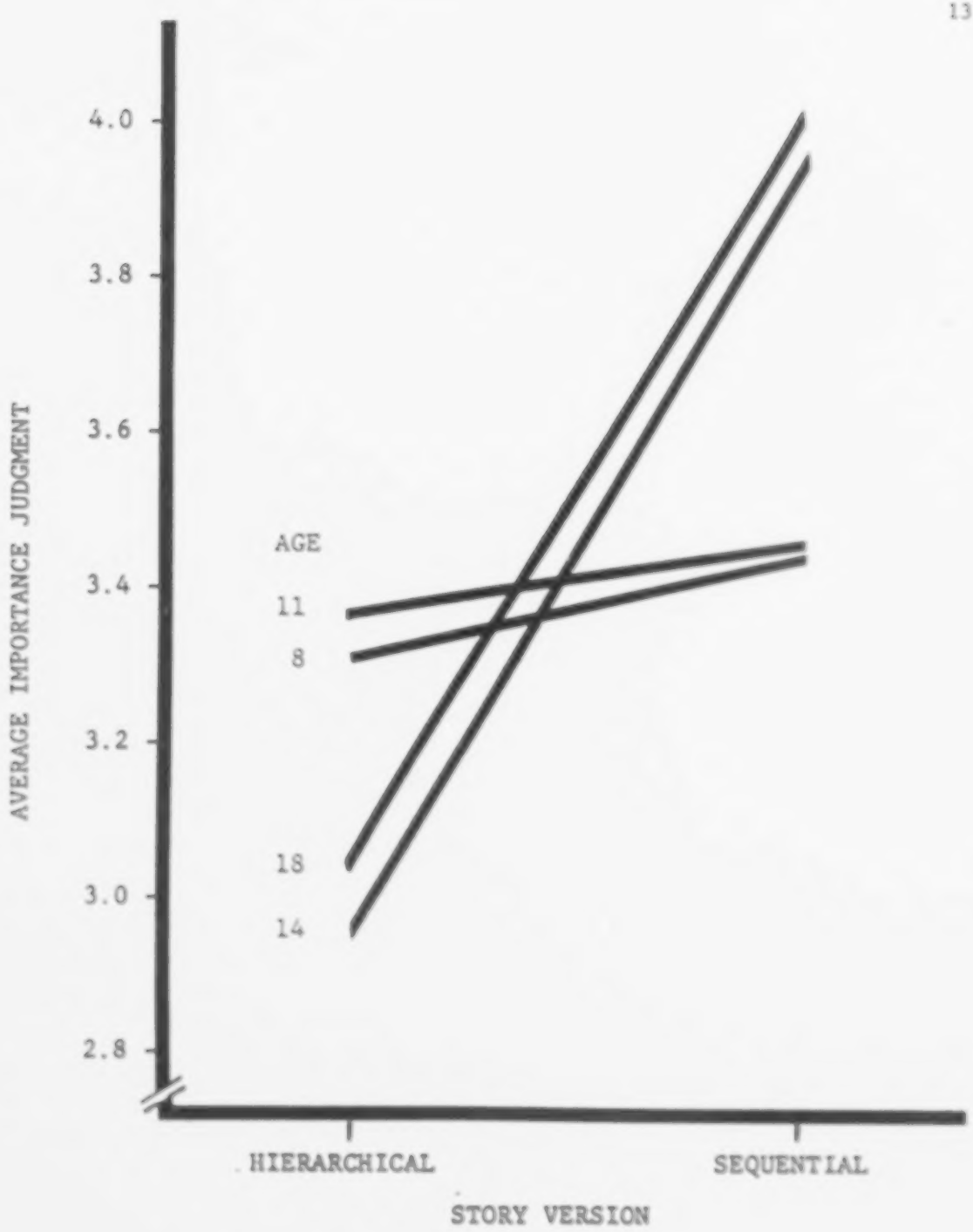



FIGURE 5. HIGHER-ORDER INTEGRATION: AVERAGE IMPORTANCE JUDGMENTSFOR SETTINGS IN HIERARCHICAL AND SEQUENTIAL VERSIONS FOR EACH AGE.

## Conclusions

1. These findings suggest that children can distinguish between important and unimportant events within an episode in a story by the time they are eight years old, and that they apply causal reasoning to do so.

2. However, as the amounts of information to be connected increase young children experience difficulty in recognizing pivotal statements. Only subjects that were eleven years and older recognize the importance of statements that interrelated and anchored episodes. Higher-order structures were not recognized until the children reached fourteen years.

3. The results attest to the central role that causal reasoning plays in the comprehension of stories. They suggest that causal inferences about relationships between individual statements provide the building blocks for representing the story. Via further causal inferences, these building blocks are put together at increasingly global levels of integration. Global coherence, then, builds upon local relations.

   Eight-year old children have the skills and knowledge necessary for the identification of local, causal relations. However, the ability to recognize the causal relations that allow global integration develops over the elementary school years. As a result, children and adults are expected to differ systematically and predictably in their representation of a story and in the use of this representation in a variety of tasks.